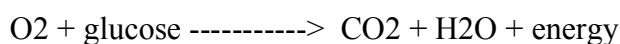


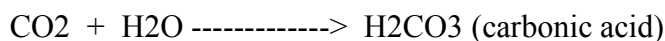
Lab: What's In Your Soil?**INTRODUCTION: The Theory**

In the last class, one of your group members was launched into space in order to collect different sample(s) from either the planet, Donner, or the moon, Blitzen. One of those samples was soil. What do you think your soil contains? Signs of life? In this lab, your team will develop and perform an experiment in order to test your samples for the presences of microorganisms. Microbes give off carbon dioxide (CO₂) during respiration. Therefore, it is possible to test your soil samples for their presence, indirectly, by determining whether or not carbon dioxide is released.

The equation for cellular respiration:

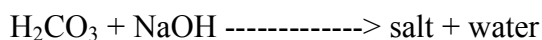


As you can see, one of the **products** of **cellular respiration** is **carbon dioxide (CO₂)**. Does this sound familiar? It should! We talked about photosynthesis in FOS I and this is just that reaction backwards! In the presences of water, carbon dioxide is converted to carbonic acid by the following chemical reaction:



So, we can test for life but we must do so by testing to see if there is the presence of carbonic acid not carbon dioxide. Why? How can you test for carbonic acid? We can use a pH indicator that will change colors when the pH changes. **Phenolphthalein** is a pH indicator that is **CLEAR** in acids (pH less than 7) and is **PINK** in bases (pH greater than 7).

You can now add drops of sodium hydroxide (NaOH), which has a high pH to your solution that would have carbonic acid in it if cellular took place. When you do this you are actually **neutralizing** the carbonic acid, H₂CO₃. This is the reaction that takes place as the carbonic acid becomes more and more basic (increased pH) with the addition of sodium hydroxide (NaOH):

**YOUR GOAL IS TO DO THE FOLLOWING:****DAY ONE: Part 1 (EXPERIMENT DESIGN Steps I through IV)**

1. In your team, DESIGN an experiment (on a separate piece of paper) to test your soil sample(s). USE the MATERIALS list and HINTS to guide you! Your design must include DATA TABLE to organize the results you are looking for

2. Write up a step-by-step procedure. You **MUST** get it approved before proceeding.

DAY ONE: Part 2

1. Get your Experiment Design approved before set-up. SET-UP your experiment. (IMPORTANT: It takes 1-2 days for CO₂ to be present in adequate amounts to test for, so your experiment must be completely set up on Day 1)

DAY TWO

1. Test your sample(s) for CO₂.
2. RECORD your results on your Data Table
3. **Complete your conclusion questions.**

DESIGN AND PROCEDURE HINTS:

Stated below in EXPERIMENT DESIGN & REPORT WRITE-UP FORMAT are the **requirements** for the **Soil Lab Design and Report**. Below are the **Materials** you have to work with, and **HINTS** on how to successfully test your sample(s). Read over the Materials and Hints carefully before you begin. **You cannot set up your experiment until you have approval from your instructor!**

1. To design an effective experiment it is necessary to include a **CONTROL**. A **CONTROL** is an experimental trial that you set up to act as a reference point for comparisons. For example, if you wanted to test whether a certain fertilizer helped a plant grow, you'd have to include another plant in your experiment in which no fertilizer was added. You could only tell whether a plant grew from fertilizer by comparing it to a plant without fertilizer. This is the role of the **CONTROL**.
(e.g. CONTROL types: don't add sugar, sterilize the soil or water, etc.)

2. When adding certain materials, use the following **CONSISTENT** amounts in EACH beaker:

<u>MATERIALS</u>	<u>AMOUNTS</u>
soil	a teaspoon
distilled water	100 mL
glucose	"pinch"
phenolphthalein solution	3 drops
sodium hydroxide (NaOH) solution	? (What we are counting)
Beakers	
Filter Paper	
Droppers	
Funnel	
Tape and Marker	

3. LABEL ALL BEAKERS with your group members' names & what the beaker is (e.g. CONTROL).
4. Make sure to include how you will test your samples after they have set out in your procedures
5. When you are setting up your experiment stop here. You will run your sodium hydroxide/phenolphthalein tests on the next class day.
5. You will need to SLOWLY and CAREFULLY filter the water from the soil in order to test for CO₂.
6. Also, make sure to test EQUAL AMOUNTS of water.
7. When adding sodium hydroxide to a solution, GENTLY swirl after EACH drop, or the carbon dioxide will escape, leading to inaccurate results.

EXPERIMENT DESIGN & REPORT WRITE-UP FORMAT

I. Introduction:

1. Theory: Include the type of reaction and explain why it will give you the desired product. Make sure that you include background information about why looking at carbonic acid is a way of looking for signs of life.

II. Materials:

1. List all chemicals and equipment needed and used.
2. **Include** drawings of your setup.
3. **You must filter your solutions before putting phenolphthalein in. Use filter paper, funnel and a ring stand.**
4. Below is a list of equipment that you might find useful. List only the materials you actually use.
 - Beakers
 - Glucose
 - Phenolphthalein solution
 - Distilled water
 - Ring stand
 - Filter paper
 - Teaspoon
 - Your soil sample
 - 01M Sodium Hydroxide solution
 - Droppers
 - Funnel
 - Tape & Marker

III. Procedure:

1. Write a **numbered, step-by-step list of the procedure. Include all amounts of the substances and materials.**

IV. Results:

1. Place your **DATA Table** here with your results.
2. Do not analyze in this section but **DISPLAY DATA ONLY!**

V. Conclusion - Write your answers to these questions in your conclusion:

1. Did you get the results expected? Did your sample release CO₂? If so, how did you know?
2. What is the purpose of adding a pH indicator to a solution?
3. Did your CONTROL allow our to make conclusions about what was in your sample, explain.
4. What caused your error, if you had any? At which step in you experiments might your error have occurred?
5. How would you improve the design of your experiment? What steps in the procedure would you change and how would you change it?
6. What scientific concepts that we learned in class did you apply to this lab?
7. What do your results tell you about your objectives for you planet or moon development plan?
 - a. Does it change anything from your original plans?
 - b. Do you have to add any precautions?
 - c. Is there something new for you to exploit or not?